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# Design Agents: A Post-acquisition Reform Cost-benefit Analysis

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Acquisition Research Program:  
Creating Synergy for Informed Change

## ***Design Agents: A Post-Acquisition Reform Cost-Benefit Analysis***

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# ***Design Agents: Overview***

- **Introduction**
- **Survey of Literature**
- **The Phenomenon: Buildup and Demise**
- **The Programs & the Research Questions**
- **Quantitative Analysis**
- **Qualitative Analysis**
- **Findings**
- **Recommendations**



# ***Design Agents: Introduction***

- By definition, they perform during *early* part of acquisition lifecycle (SD&D). Roles include:
  - Requirements Generation
  - Technology Development
  - Systems Integration
  - Other (Source Selection, Supply Chain Management, Testing, Validation)
- “Design Agent” sometimes synonymous with “Lead Systems Integrator”
- ... all premised on the notion that Industry is more efficient, performing traditionally (but not inherently) Governmental functions



# ***Design Agency & Acquisition Reform: Changing Climate***

- **Post-Cold War: Dramatic DoD budget cuts**
- **Resource scarcity -> Reforms of 1990s**
- **FARA of 1996 – host of competing values (Efficiency vs. Fairness, Accountability, Transparency)**
- **Ten Years Later: Political / Regulatory Climate Changes**
- **Public-Private Sector Dynamics**

***Where are we now? Who's really in charge?***

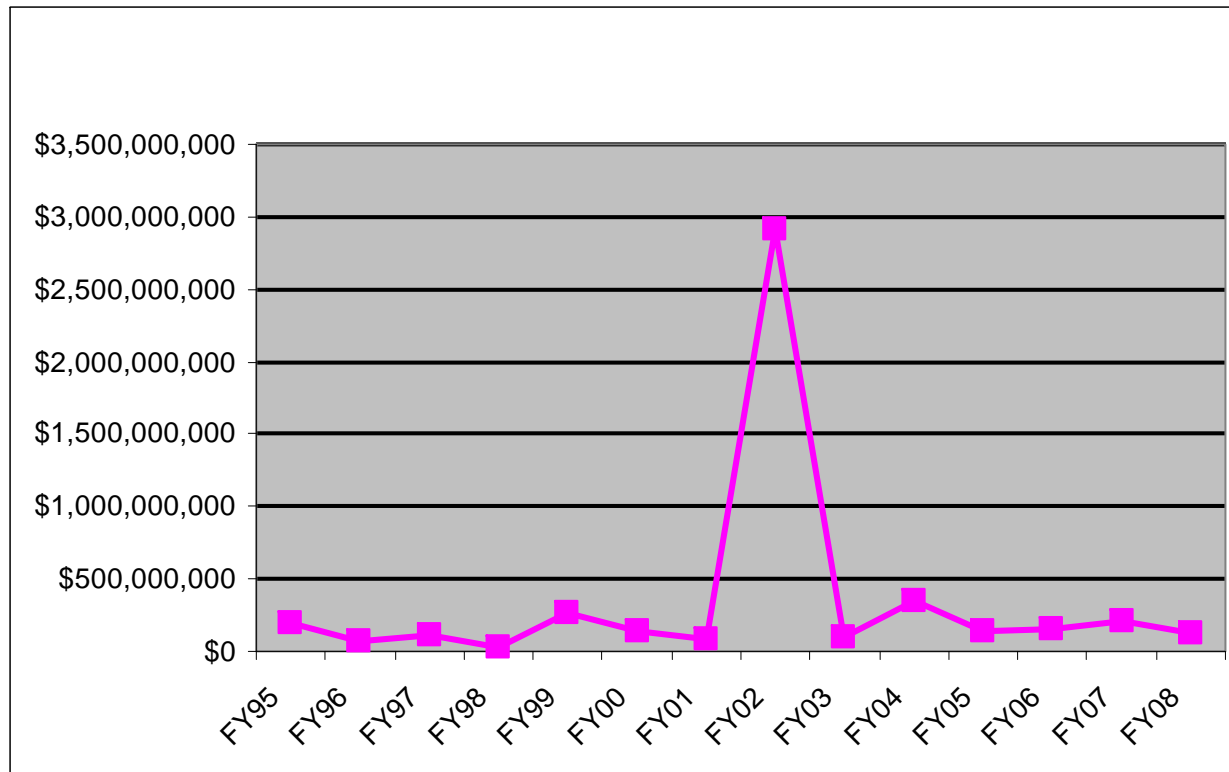


# ***Survey of Literature and Theory***

- **No Rigorous Analyses of Design Agency...yet!**
- **Contracting Out Debate (Goodsell, 2007; Globerman & Vining, 1996; Smith & Smyth, 1996; Miles & Snow, 1992)**
- **Demanding Customer and the “Hollow Organization” (Crawford & Krahn, 1998; Rickover, 1962)**
- **Lead Systems Integrator (Army’s Future Combat System – Flood & Richard, 2005)**
- **Large-Scale Systems Integration (Baron, 2007)**
- **Besal & Whitehead (2001): Contractors in T&E**



## ***Design Agent Contracts: Dollar Value Climaxed in 2002 with DD(X) ~\$3B***



**Source:** <http://www.defenselink.mil/contracts/archive.aspx>





# ***Design Agent Contracts: Prevalence***

- **1995-2001:** Dozens of announcements for Design Agent work (Mk41 VLS, AN/SQS-89, PFG-2, Mk15 CIWS, CEC)
- **2002:** Phenomenon climaxed with ~\$2.9B Design Agent contract award for DD(X)
- **2003-2008:** Purity of Design Agent work increasingly suspect (DDG-51 class services, etc.)





# ***Design Agent-Led Programs: Mk 41 VLS***



*Photo: Global Security.org*

**Lockheed Martin:** Design Agent for software, systems engineering and integration of Mk 41 Vertical Launching System.

**United Defense Limited Partnership** (now BAE Systems): Design Agent for structural and mechanical portions, VLS canisters.

**> \$91M in contract awards**



# ***Design Agent-Led Programs: Trident Missile***



## ***Charles Stark Draper Lab***

Design Agent for MK-2, MK-3, MK-5,  
and MK-6 guidance test equipment

***>\$276M in contract awards (FY95\$)***

*Photo: Massachusetts Institute of Technology*



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# ***Design Agent-Led Programs: Mk 53 DLS***



*Photo: U.S. Navy*

## ***Sippican (now Lockheed Martin)***

Hardware, Software, Systems Engineering  
& Design Agent services for Mk 53 Decoy  
Launching System.

***>\$5M in contract awards (FY01\$)***



# ***Design Agent-Led Programs: Mk 92 FCS***



## ***Lockheed Martin***

Design Agent Engineering & Tech Support  
for Mk 92 Fire Control System.

***>\$43M in contract awards (FY06\$)***

*Photo: GlobalSecurity.org*



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# ***Design Agent-Led Programs: CIWS***



## ***Raytheon***

Engineering & Design Agent Services for Mk 15 PHALANX Close-In Weapon System.

***> \$16M in contract awards (FY99\$)***

*Photo: Defense Industry Daily*



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# ***Design Agent-Led Programs: SM-2***



*Photo: U.S. Navy*

## ***Raytheon***

Design Agent services and test equipment for Standard Missile 2.

***> \$65 million in contract awards***



# ***Design Agent-Led Programs: CEC***



*Photo: U.S. Navy*

## ***Raytheon***

Design Agent to support existing Cooperative Engagement Capability baselines, equipment and computer program installations at Raytheon's engineering labs, land-based test sites, Navy field activities, Fleet assets and other Government assets.

***> \$200 million in contract awards***





# ***Design Agent-Led Programs: Nuclear Subs***



*Photo: U.S. Navy*

## ***Electric Boat (now General Dynamics)***

Design Agent services for submarines and shore facilities.

***> \$800 million in contract awards***



# ***Design Agent-Led Programs: DD(X)***



*Art: DDG1000.com*

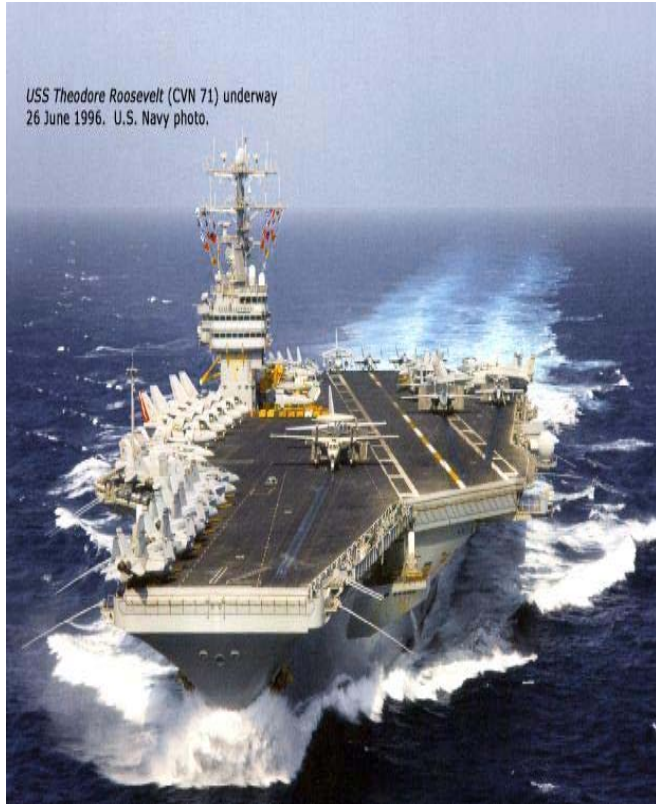
## ***Ingalls Shipbuilding (now Northrop Grumman)***

Agent for the design, build and test of engineering development models for major subsystems and components for the DD(X) class of destroyers. Note: When program transitioned to Detail Design Integration phase, acquisition strategy changed.

**> \$2.9 Billion in contract awards (FY02\$)**



# ***Design Agent-Led Programs: Carriers (Ship Alts & Logistics)***



*Photo: U.S. Navy*

## ***Newport News (now Northrop Grumman)***

Design Agent for ship alteration and logistics support packages.

***> \$20 million in contract awards (FY04\$)***



## ***Design Agents: Research Questions***

- **Has the Design Agent phenomenon driven up acquisition costs for DoD programs?  
(Quantitative Analysis)**
- **Have Design Agent initiatives generally weakened DoD's ability to coordinate and control its major programs?  
(Qualitative Analysis)**



# ***Design Agent vs. Navy-Led: Programs Studied***

## **Cooperative Engagement Capability (Raytheon)**

- Hardware and software
- System of sensors

## **Virginia-Class Submarines (Electric Boat)**

- System of systems

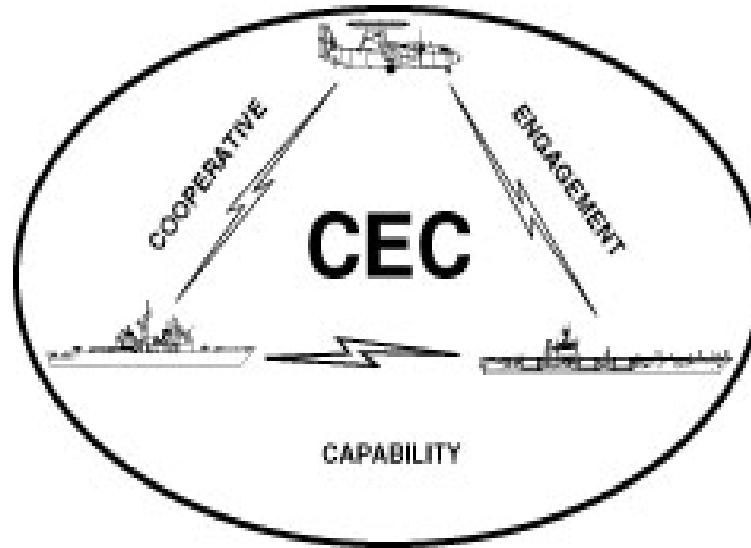
## **Arleigh Burke Destroyers (Navy)**

- System of systems





# ***Cooperative Engagement Capability***



**Recurring SCN estimates range from \$6.586M to \$11.23M**

**Raytheon performed Design Agent role; however...**

**Naval Surface Warfare Center Dahlgren was Software Support Activity and *Systems Engineering/Integration Agent.***

**Johns Hopkins University Applied Physics Lab was Technical Direction Agent, *developing specs and prototyping systems.***



# ***Virginia-Class Subs***

**Recurring SCN estimates of \$1.9B (FY05\$) were based on two ships per year and joint-production efficiency.**

**Actual Average Unit Production Cost of ~ \$2.3 billion (FY05\$) were driven by long production breaks and quantity of one ship per year.**

**Electric Boat (GD) was Design Agent; Northrop Grumman was alternate shipbuilder.**





# ***Arleigh Burke Destroyers (DDG 51)***



*Photo: U.S. Navy*

**First Ship was ~ \$1.1B (FY85\$)**

**AUPC for Follow Ships ~ \$900M (TY\$)**

**Volatility driven by cost-quantity relationships, as well as industrial base concerns and program interdependencies (delay of DD-21; alignment of LPD-17).**

**Strong Navy leadership steered DDG-51 to long-term success.**

**Navy was Design Agent; Lockheed Martin was Combat Systems Integrator.**

**Bath Iron Works & Ingalls: Shipbuilders.**



# ***Design Agents: Case Studies***

- **Cooperative Engagement Capability:** Ongoing development & improvement (~20 years) overseen by well-balanced team.
- **Virginia Class:** Cost overrun driven by cost-quantity relationship and schedule dynamics.
- **Arleigh Burke Class:** Conscientious balancing of cost-quantity relationship and program interdependencies by Navy leaders.



## ***Design Agents: Findings***

- **Cost comparisons of “Design Agent”-led programs to traditional DoD-led programs are difficult, as roles often transcend labels.**
- **Cost comparisons of Military / civilian / contractor personnel are straightforward, but must be understood in (qualitative) context.**
- **Cost-sharing arrangements (Facilities, Software) as well as intra-Government transactions (GFE/GFI) must be clearly understood.**



## ***Design Agents: Findings***

- **Delegation of leadership responsibility puts the Navy's technical competence and program-management capacity at risk.**
- **Pressured by profit watchers, industry may sacrifice quality to meet schedule and cost goals.**
- **Poor progress is often discovered too late.**
- **Concentration of industry power**
  - **Stifles innovation / erects firewalls**
  - **Decreases diversity of subcontractors**
  - **Compromises fair business practices**

***Best arrangements balance power among FFRDCs, Industry, and Government entities.***



# ***Recommendations***

***“...another order of attenuation is reached when contractors do all the managing related to the mission.”***

***– Goodsell, 2007***

- **Boost Government role throughout development**
- **Rebalance risk and rewards for all**
- **Re-invent the Navy’s personnel system**
- **Re-ignite competitive zeal**



## ***Concluding Thoughts...***

- **Continue to weigh costs and benefits, as market forces influence opportunities for competition, expansion of supplier base, and as regulatory changes create new dynamics.**
- **Stay tuned to political feasibility & public trust issues, as well as evolving norms for business practices in times of war.**
- **The policy cycle never ends!**

